

# Large-Scale Mobile Ad-Hoc Networks Based on Markets

Prepared for:  
Far Out Networking Symposium

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07 August 2013



# MANETs fail due to localized decision-making

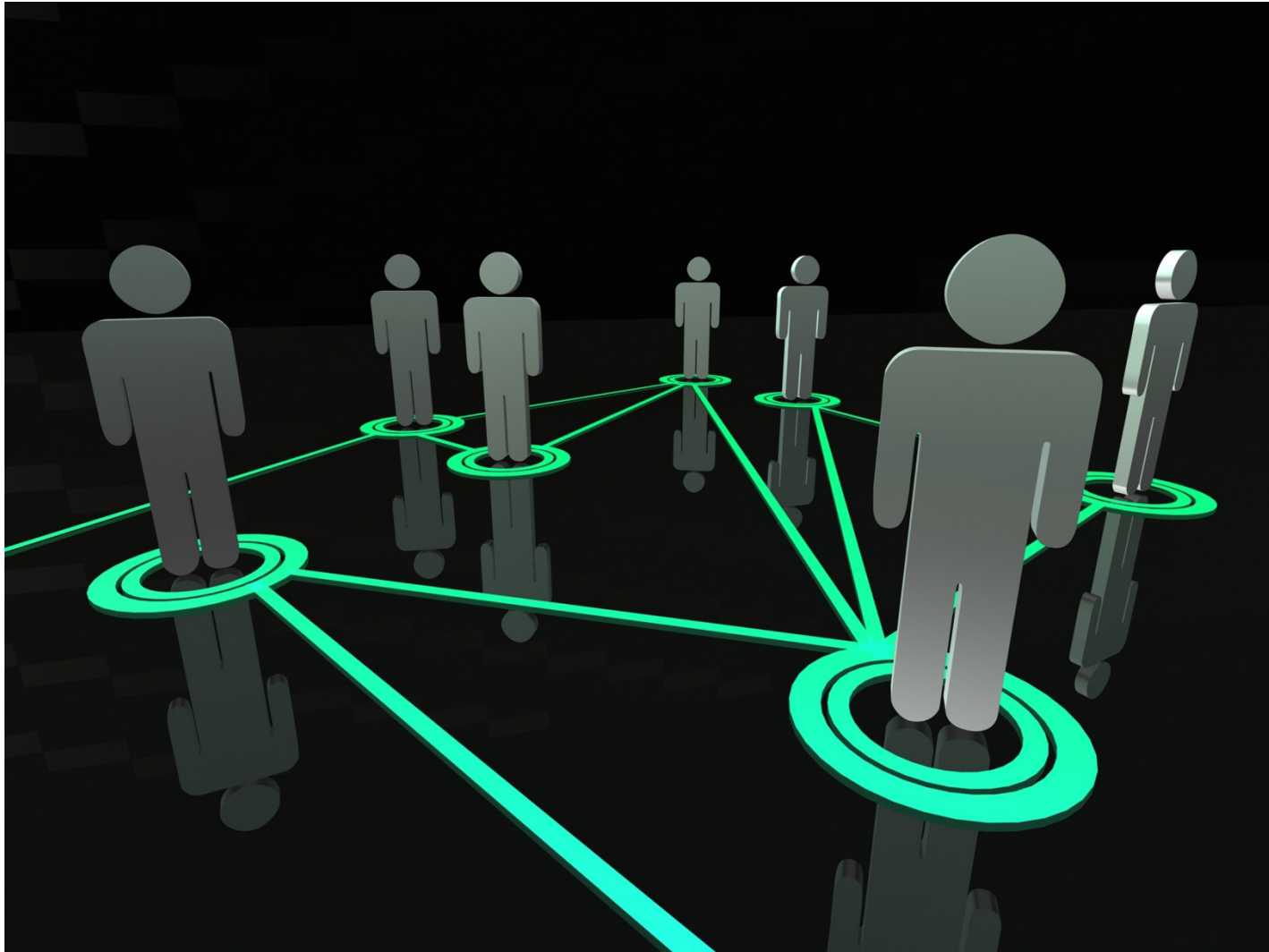


**Solitary  
Individuals**

instead of

**Collaborative  
Crowd**

# Ideal world: information is automatically matched between producer and consumer





# Reality is different

- Participants are selfish and myopic
- Sender is the primary Decider
- Process is rigid and linear

# Participants are selfish and myopic

- Pro: allows local optimization and distributed computation
- Con: leads to global inefficiencies
  - Especially bad for low resource and dynamic MANETs





# Sender is the primary Decider

- Who to send to
- How to send
- What to send

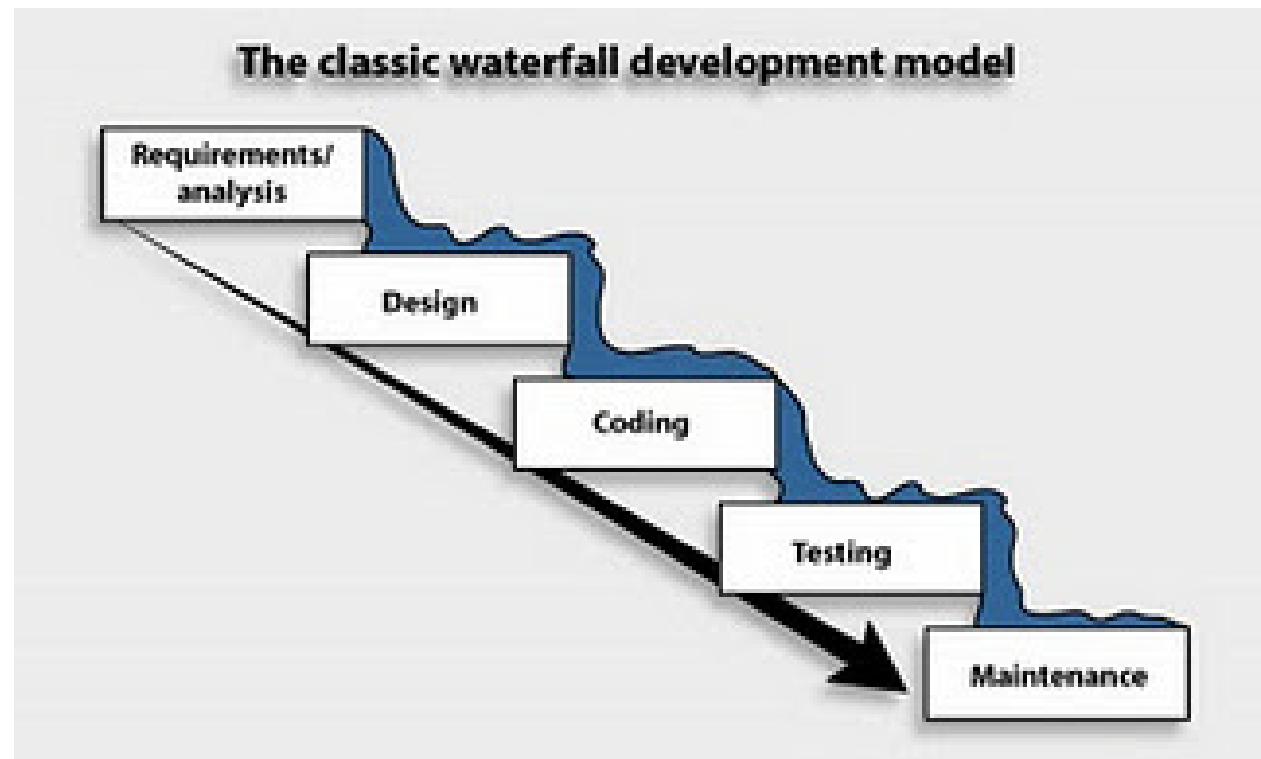




## Process is rigid and linear

1. Seller announces goods
2. Customer selects goods
3. Seller initiates transmission
4. Network implements transmission

**Waterfall  
anyone?**

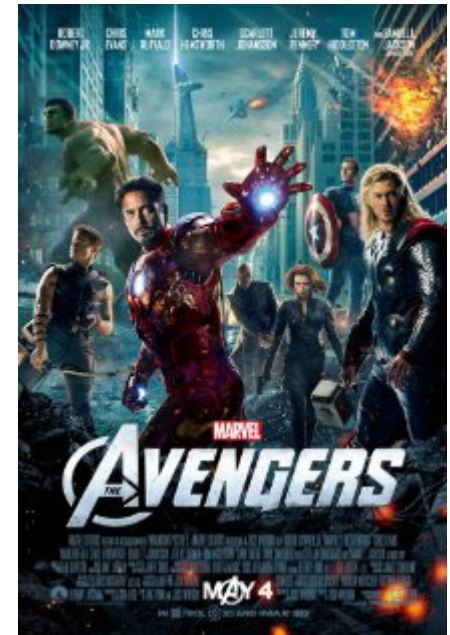






## Example: video streaming

1. Netflix and other vendors publicize their videos and prices
2. Viewer selects Avengers from NetFlix
3. NetFlix begins streaming from its CDN
4. Packets are sent from CDN to viewer's IP address







## Example: consumption of sensor data

1. Sensor network broadcasts availability of new data
2. Warfighter requests data
3. Sensor network sends data
4. Packets are sent from sensor network via multiple intermediate networks (e.g., airborne network, ground radio network)





## Challenge: find optimal solution for all participants

- Make the best decision given available knowledge
- Let all of the participants contribute to the decision-making process
- Adapt over time



# Solution: artificial marketplace

- Marketplace facilitates emergent behavior from selfish participants



- Multiple resources (e.g., bandwidth, CPU, power) can be optimized and exchanged simultaneously
- Marketplace automatically adapts to changes
- Multiple marketplaces provide flexibility



# Multiple resource market for multivariate optimization

- Multiple network resources (e.g., CPU, bandwidth, power) can be simultaneously optimized
- Resources can be traded off each other

## Market adapts to changes

- Changing mission priorities and resource availability can be modeled by adding/removing currency
- Network resources (e.g., sensors, computers, radios, Warfighters) can join and leave
- Quickly finds new solutions



# Distributed markets provide flexibility

- Provide resilience to network changes
- Distribute computation
- Minimize overhead because the impact of local decisions can mostly be kept local
- Incurs some cost due to market inefficiencies



## Based on market principles

- Principles of economic theory developed over time
- Artificial market embodies economic principles without the complications of the real world
- Successfully applied to dynamic optimization of radar assets, sensors, and network resources





# Market-based approach to resource management

- Allows globally optimal behavior to emerge from local optimization
- Adapts to changing MANET conditions
- Provides resiliency

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